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HONEST 1 : PERSONALITY, HEART RATE, URINARY CATECHOLAMINE, AND SUBJECTIVE FATIGUE MEASURES RELATED TO NIGHT NAP-OF-THE-EARTH FLYING

DEPARTMENT OF BIOMEDICAL STRESS
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Personality, subjective fatigue, urine catecholamine, and heart rate measures of helicopter pilots that participated in a night nap-of-the-earth training exercise were evaluated. These selected variables provided estimates of normal personality function, subjective feeling states, and biochemical and physiological changes. According to the hypothesis, these variables are related with night nap-of-the-earth flying. Scores on the Self-acceptance and Achievement via Independence scales of the California Psychological Inventory (CPI) were (cont)

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significantly above the mean for pilots rated as above average ability. Additionally, the CPI scales of Self Control and Good Impression were significantly related to urine catecholamine levels. Heart rate levels were significantly related to epinephrine, but not to norepinephrine. Despite the significant increases in epinephrine within flights and norepinephrine across flights, there were no significant increases in perceived anxiety, as measured by the State-Trait Anxiety Inventory. The lack of increase in perceived anxiety may be explained by the processes of dissociation and the general adaptation syndrome.

ABSTRACT

Personality, subjective fatigue, urine catecholamine, and heart rate measures of helicopter pilots that participated in a night nap-of-the-earth training exercise were evaluated. These selected variables provided estimates of normal personality function, subjective feeling states, and biochemical and physiological changes. According to the hypothesis, these variables are related to night nap-of-the-earth flying. Scores on the Self-acceptance and Achievement via Independence scales of the California Psychological Inventory (CPI) were significantly above the mean for pilots rated as above average ability. Additionally, the CPI scales of Self Control and Good Impression were significantly related to urine catecholamine levels. Heart rate levels were significantly related to epinephrine, but not to norepinephrine. Despite the significant increases in epinephrine within flights and norepinephrine across flights, there were no significant increases in preceived anxiety, as measured by the State-Trait Anxiety Inventory. The lack of increase in perceived anxiety may be explained by the processes of dissociation and the general adaptation syndrome.

PREFACE

We wish to extend our appreciation to all members of the Honest I team for their cooperation during this project. A special note of appreciation is offered to MAJ Melecio Z. Santos and MAJ Carl S. Gerhart of the U.S. Army 155th Aviation Company at Fort Ord, California, for their efforts which enabled this collaborative project to be completed. We also wish to thank LTC Frederick A. Isgrig and CPT Paul Best of the Combat Development and Experimentation Command (CDEC) for their efforts in initiating this project. Appreciation is also extended to Dr. James Skala and Mr. Myron Knight of the Biochemistry Division of the Letterman Army Institute of Research for processing the urine catecholamine samples. Finally, recognition is offered to SSG Robert L. Jones for his technical assistance during this project.

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HONEST I: PERSONALITY, HEART RATE, URINARY CATECHOLAMINE, AND SUBJECTIVE FATIGUE MEASURES RELATED TO NIGHT NAP-OF-THE-EARTH FLYING

INTRODUCTION

Nap-of-the-earth (NOE) flying has been proposed to be an effective means whereby rotary wing aircraft may avoid early detection by radar (1). NOE flying differs from contour (just above treetop level) and low level flying (altitudes up to 100 m above ground level); In NOE flying the pilots use the natural terrain to conceal their maneuvers. During such maneuvers the pilot will fly at or below treetop level and will use rivers and other natural-occurring conformations to avoid contact with enemy forces. While daylight NOE flying places a greater demand on the skills of the pilot than contour or low level flying, night NOE flying intensifies these performance requirements even more (2). Under such conditions, the pilot must be thoroughly familar with the terrain and must be able to react quickly to unexpected obstacles.

Training techniques to assist in preparing pilots to fly NOE at night have not been standardized. The absence of such training procedures is due in part to (a) the non-availability of night observation devices which can fully meet the needs of pilots in combat and (b) lack of knowledge of the specific individual performance factors required to complete night NOE profiles successfully. The night observation devices, instruments such as night vision goggles (NVG), are currently being improved and tested (2,3). However, flashes of light can cause the NVG to become temporarily inoperative. Further work must be done on the NVG before such devices can be used reliably in night operations (3).

Performance factors specifically related to night NOE flying require individual capacities for functions such as cognition, psychomotor performance, and/or motor activities, i.e., the some basic skills that are acquired early in pilot training and are refined with experience. Two additional performance factors to be evaluated in this report involve personality variables and the subjective experience of fatigue. Personality characteristics of individuals account for substantial amounts of individual variability in performance in a variety of situations (4). With specific reference to helicopter pilots, it has been reported that involvement in accidents was significantly related to several of the personality factors measured by the 16-Personality

1. Kimball, K.A. et al, Report No. 75-3. Ft. Rucker, AL: USAARL, September 1974
2. Lees, M.A. et al, Report No. 76-27. Ft. Rucker, AL: USAARL, August 1976
3. Lees, M.A. et al, Report No. 77-3. Ft. Rucker, AL: USAARL, December 1976
4. Eysenck, H.J., The Biological Basis of Personality. 1967

Factor Questionnaire (5). These findings (5) suggest that individuals who are developing night NOE training procedures should be aware that "normal" personality differences may affect performance.

The subjective manifestations of fatigue have been proposed to play an important role in limiting performance of many tasks (6-8). Additionally, it has been proposed that the subjective experience of fatigue is comprised of general and specific states (i.e., factors). The specific states are the ones which differentiate the subjective experience of one situation from another (9). When applied to flying such information may indicate physiological and/or psychological changes that alter performance.

It is anticipated that the level of stress associated with the NOE night training flights will be greater than those levels associated with less-demanding types of flying. Selye (10) reported that when animals were exposed to several nonspecific stressful treatments or agents, a stereotyped pattern of physiological changes occurred. Later Selye (11) ermed this response pattern as the general adaptation syndrome and the stimuli which elicit the syndrome as stresses and stressors. Subsequent to these reports, the first sensitive and relatively specfic method for determining corticosteroids in blood was established (12). Detection of adrenocortical activity under stress supported Selye's earlier work and demonstrated the usefulness of changes in biochemical levels as indicies of stress.

Various psychophysiological measures (e.g., galvanic skin response, heart rate, blood pressure, muscle fiber activity) have been used to study stress both in the laboratory and in the field (13-18). However, to study stress in helicopter pilots performing field exercises places limits on the availability of the subjects and the degree to which they

5. Sanders, M.G. et al, Report No. 75-1. Ft. Rucker, AL: USAARL, July 1974
6. Weiser, P.C. et al, Med Sci Sports 5:79, 1973
7. Kinsman R.A. et al, Ergonomics 16:211, 1973
8. Stamper, D.A. et al, Percept Mot Skills 33: 735, 1971
9. Stamper, D.A. Physiological, Psychological, and Symptomatic Factors Affecting Prolonged Physical Performance. Masters Thesis. Univ. of Colorado, 1976
10. Selye, H.A., Nature 138, 1936
11. Selye, H.A., J Clin Endocr 6:117, 1946
12. Montcastle, V.B., Medical Physiology. 1974, p 870
13. Mc Grath, J.E. (Ed.), Social and Psychological Factors in Stress. 1970
14. Elliott, R., J Pers Soc Psychol 3:353, 1966
15. Fenz, W.D., Psychol Monogr: Gen Appl 78(8, Whole No. 585), 1964
16. Katkin, E.S., J Pers Soc Psychol 2:324, 1964
17. Schachter, S. et al, Psychol Rev 69:379, 1962
18. Grossman, S.P., A Textbook of Physiological Psychology. 1967, p 513

can be physiologically evaluated without disrupting the mission. In another study (Leibrecht, Lloyd, and O'Mara. Field study of stress: Psychophysiological measures during Project SUPEX. LAIR Institute Report, in preparation, 1978), surface electrodes and small magnetic tape cassette recorders were used to monitor heart rates of troops in the field. This procedure was unobtrusive to the subject and allowed for continuous monitoring of heart rate. Another procedure which has been used with airline pilots (19) involves collections of urine samples. Analyses of the urine samples of the pilots revealed that changes in the catecholamine levels occurred during the flights. Both of these test procedures meet the requirement of being relatively unobtrusive and they provide a means for evaluating the acute and chronic affects of stress which are expressed psychophysiologically.

The purpose of this investigation/study was (a) to determine if normal personality characteristics exist which may account for performance differences among pilots during night NOE training operations; (b) to evaluate the subjective experience of these pilots during night NOE training exercises which may reflect individual physiological and/or physiological changes that affect their performance; (c) to evaluate potential predictive relationships between psychophysiological and biochemical parameters and success in night flight training; and (d) to assess the relationships between psychophysiological and biochemical indicators of stress. Subjective fatigue did not change significantly from preflight to end-of-flight, however several of the California Psychological Inventory (CPI) scales were related to pilots rated as above average. CPI scales were also related to urinary catecholamines that were found to change across flights and sessions.

METHODS

The subjects in the project were eight U.S. Army Officers (Commissioned or Warrant) assigned to the 155th Aviation Company at Ft. Ord, California. The ages of the pilots ranged from 22 to 32 years. Their total carrer flight hours averaged 1561.2 hours, ranging from 252 to 2742 hours. Previous hours of night flying averaged 194.4 ranging from 11 to 579 hours. These aviators were selected from a larger group of volunteers by the Commander of the 155th Avaiation Company. The Commander selected these pilots on the basis that he believed that they had the abilities and qualitites to complete the training exercise successfully.

A second group of twelve pilots were selected for comparison of personality factors. These pilots were tested following the study of the eight subjects in the NOE training exercises. The 12 pilots were rated according to their abilities as helicopter pilots by the Commander of the 155th Aviation Company. The ratings were superior, average, and below average. The scale profiles of two pilots appeared to reflect a

19. Mason, J.W., Psychom Med 30(5. Part 2):631-653. 1968

random response pattern (20) which suggests that they marked the answer form without regard to the questions. These subjects were consequently dropped from further consideration. This decreased the number in the average and below average groups by one pilot each. The five aviators from these two groups were combined to form an average-to-below-average group and the remaining five comprised the superior group. The five pilots in the superior group were also instructor pilots (IPs) for the eight subjects in the NOE training exercise.

The personality characteristics of the pilots were evaluated by use of the CPI, the Eysenck Personality Questionnaire (EPQ) (21), and the State-Trait Anxiety Inventory (STAI) (22). The 18 scales of the CPI are characterized and interpreted according to four categories: (a) poise, ascendance, self-assurance and interpersonal adequacy, (b) socialization, responsibility, interpersonal values, and character, (c) achievement potential and intellectual efficiency, and (d) intellectual and interest modes. The EPQ developed by Eysenck is an updated form of the Maudsley Personality Inventory with scales that have been related to extroversion-introversion, neuroticism, psychoticism, and a lie scale. The STAI contains two parts which reflect "state" anxiety and "trait" anxiety; however, after the briefing session only the State part was administered on a repeated basis. State anxiety refers to a transitory emotional state or condition while trait anxiety is conceptualized as a relatively stable characteristic which reflects anxiety proneness. All tests were administered according to the standard procedures that are outlined in their respective test manuals (20-22).

A questionnaire to assess both the subjective (i.e., "perceived" (23)) and physical aspects of fatigue was designed for the present study. Several subscales within the Physical Activity Questionnaire (PAQ) (6,7) and the General High Altitude Questionnaire (GHAQ) (8), and sone new items (e.g., on arm fatigue) were combined into one inventory called the General States Questionnaire (GSQ) which is presented in Appendix A. In designing an appropriate questionnaire for the present study it was decided to use several of the subscales within the PAQ and GHAQ. Additionally, since the arms are also used while flying a helicopter it was decided to develop new items similar to the leg fatigue items of the PAQ for inclustion in the new questionnaire. These new items were included with the knowledge that interpretation of any significant changes would have to be made cautiously since the reliability and validity estimates for these items have not been determined. These arm fatigue items were scaled using the same adjectives

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20. Gough, H.G., California Psychological Inventory Manual. Palo Alto, CA: Consulting Psychologists Press, Inc., 1975
21. Eysenck, H.J. and S.B.G.Eysenck, The Manual of the Eysenck Personality Questionnaire. San Diego: EDITS/ Robert Knapp, Publisher,1975
22. Spielberger, C.D. et al, STAI Manual, Palo Alto, CA: Consulting Psychologists Press, Inc., 1970
23. Borg, G., K Frysiogn Saellsk 31:105, 1961

that were used to scale the leg fatigue items. All of the subscales were then combined into one inventory called the General States questionnaire. To obtain a subscale score the raw score ratings of the items that comprised each subscale were summed; items were rated 1 through 5 (1 equals the best condition and 5 equals the worst condition). Therefore, an increase in a subscale score would be indicative of an increase in the symptomatology represented by those items.

This study was a collaborative effort with the CDEC, Ft. Ord, California. The team from LAIR did not initiate its portion of the collaborative project until 21 days after the initiation of the training exercise by CDEC. On the twenty-first day of the exercise, the subjects/pilots were assembled is a mobile trailer located at the flight line. The LAIR team explained the purpose of this phase of the project and the pilots were given an opportunity to ask questions. Subsequent to the briefing, the pilots were asked if they would participate in this phase of the project and to sign a volunteer statement which acknowledged that the intent of this phase and the possible health hazards had been explained to them (Appendix B). At this time each subject also drew a number to identify his data for the remainder of the project. This procedure was requested by the Human Use Committee of LAIR to ensure the anonymity of information from each participant. Following the orientation, the CPI, EPQ, STAI, and GSQ were administered.

Subsequent to this initial data collection period, data were collected during one demonstrateion flight and two NOE training flights. Intervals of approximately one-week separated the data collection periods. The pilots were on an inverted schedule in the field and normally reported to the airfield between 1800 and 1830 hours, which was immediately after the evening meal. Subjects were assigned to fly NOE as either navigator or pilot during one of two flight periods which fell during the hours of darkness, approximately 1900-2300 hours and 2400- 0400 hours. Each subject trained in either the OH-058 or the AH-1G helicopter for the entire duration of the exercise. The actual NOE run required approximately 45 min (excluding preparation and approach time) to fly one of several predesignated routes plotted on topological maps. External illumination varied because of variation in the amount of moonlight and starlight present during the NOE runs. The light conditions and tasks for the three flights were as follows: control flight (demonstration), ride with instructor under high-light conditions (three-quarter moon); NOE flight 1, navigate under mid-light conditions (one-quarter moon); and NOE flight 2, pilot under low-light conditions (no moon). Counterbalancing of light conditions and tasks was not possible under the schedule constraints of the Program of Instruction.

Data collection periods were restricted to Tuesday and Wednesday nights to avoid possible disruptive influences of the weekend. On each of the four selected nights GSQ and STAI data, electrocardiographic (ECG) recordings, and urine samples were obtained. Due to the limita-

tions imposed by the field gear, placement of the three ECG chest electrodes was approximately equivalent to V_4. While the ECG tapes were continuously recorded, the GSQ and STAI were completed and the urine samples were obtained immediately preceding and following each flight. In answering the preflight GSQ and STAI, the pilots were asked to report how they were feeling at that moment; in answering the post-flight questionnaires, the pilots were asked to describe how they felt during the last ten minutes of their NOE runs. Subjects were asked to empty their bladders approximately two hours before the start of each flight and then were asked to empty their bladders for urine samples immediately preceding and following each flight. This allowed for the collection of urine samples with a known cumulation time. Each urine sample was adjusted with hydrochloric acid to reduce the pH to the range of 4-5 and then it was stored on ice. Urinary catecholamines (epinephrine and norepinephrine) were subsequently analyzed by means of commercially available kits (BIO-RAD Laboratories, Richmond, California) which contain standard ion exchange columns and fluorometric quantification. Catecholamine values were expressed as μg/g of creatinine. This method was selected recognizing the possibility that exogenous and endogenous sources of creatinine could affect the results. However, it was felt that since the duration of urine collection periods were not rigidly fixed, to express catecholamine values in terms of μg/2 hr period would not improve these estimates.

The population means reported by the publisher (20) were used to dichotomize the CPI scale scores which were then statistically evaluated with the use of the two-tailed proportion test (24). The preflight to end-of-flight comparisons of the State portion of the STAI were made by subjecting these data to t-tests for related samples analyses (25). The epinephrine (free and total) and norepinephrine (free and total) data were analyzed separately by means of a 3 x 2 factor analysis of variance (ANOVA) with sessions (i.e., the three flights) and time periods (preflight and inflight) treated as repeated measures variables. Post hoc comparisons of significant ANOVA results were made with the Neuman-Keuls test (26). The correlation coefficients reported in the correlation analysis section were Spearman rank-order correlation coefficients (27).

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24. Bruning, J.L. and B.L. Kintz, Computational Handbood of Statistics. 1968
25. Ferguson, G.A., Statistical Analysis in Psychology and Education. 1966
26. Winer, B.J., Statistical Principles in Experimental Design. 1971
27. Siegel, S., Nonparametric Statistics for the Behavioral Sciences. 1956

RESULTS

The pilots selected were those who were expected to complete the NOE training exercises successfully; therefore, they were presumed to represent an above average group. Supportive evidence for the success of the selection procedure is offered by the fact that only one pilot was unable to complete all of the training requirements. This issue is critical to interpretation of the findings since the anonymity maintained throughout the data collection phase precluded the evaluation of possible relationships between LAIR's data and the performance data collected by CDEC. The evaluation of the personality data was confined to the identification of patterns of scores which could influence the success of such training exercises.

Personality Factors

The CPI scores of the eight pilots are presented in Table 1 and visually depicted in Figure 1. An initial evaluation of the scores across the four broad catagories revealed no pattern of scores which differed significantly from published norms (20). More specifically, the scores appeared to be distributed normally about the mean (mean Z score = 50).

Following the overall evaluation, each scale was examined individually. It was found that, with one exception, all scores on the Self-acceptance (Sa) and Achievement via Independence (Ai) scales were above the population mean (24). Statistical evaluation of both Sa and Ai scales showed that the proportion of pilots with scores above the mean was significantly greater than would be predicted from the population means ($p<0.05$).

The CPI scores for each of the other two groups of pilots are also presented in Table 1 and Figure 1. If the CPI scores of the five instructor pilots are combined with the scores of the eight subject/pilots, the data would represent, with one exception, responses of successful night NOE trained aviators. The CPI scores of 12 of the 13 pilots for both Sa and Ai scales are observed to be above the mean. The statistical comparison of this group for the Sa and Ai scales was significant ($p<0.05$). This pattern was not true for the average-to-below-average group, where scores for four of the five pilots were below the mean on at least one of the two scales. Also, four of the five IPs had scores above the mean across the scales of the entire first category, i.e., interpersonal adequacy.

The means and standard deviations for the scales of the Eysenck Personality Questionnaire for the eight subjects are presented in Table 2 and Figure 2. The values for the IPs and the group rated average-to-below-average have also beeen included. The normative data usually required for a complete interpretation are unavailable; however,

preliminary data from two groups of college students and a group of psychiatric aids (made available by the publisher) are included in Table 2. Comparison of the mean values for the eight pilots with the preliminary data from the students and aids does not reveal any substantial differences on any of the four scales. This pattern can also be observed in the scores of the five IPs and the five pilots rated average-to-below-average. Therefore, no statistical analyses of these scores were attempted.

Limited information regarding anticipatory reactions is available among the STAI data. These data are presented in Table 3. The mean State score for the eight subject-pilots at the time of the initial briefing was 35.00, which compares closely to the control mean for undergraduate students (36.35) reported by others (22). As can be seen in Table 3, mean State scores decreased from the preflight period to the end-of-flight period during the demonstration flight and NOE flight 1. Mean State scores during NOE flight 2 increased from the preflight period to the end-of-flight period. None of these changes were statistically significant.

Subjective Fatigue

The GSQ data from the three flights are presented in Figure 3. This figure shows, for each subscale, preflight (P) and end-of-flight (F) measures for the control flight and both NOE flights. No obvious differences in the patterns of scores on the GSQ scales for the three flight conditions are apparent. The preflight to end-of-flight changes that can be seen in Figure 3 were minimal, especially when compared with changes reported previously (6). These findings suggest that, subjectively, piloting the aircraft under low-light conditions produced no more fatigue than did navigating under mid-light conditions or observing during the control flight. Information from a follow-up questionnaire which asked the subjects to assess the validity of the GSQ scales indicated that the most salient aspect of their subjective reactions to this training exercise involved preflight nervousness. It was the subjects opinion that preflight nervousness was not assessed by the GSQ.

Catecholamine Measures

The urinary catecholamine data are presented in Table 4. Summary statistics from the 3 x 2 factor ANOVA are presented in Table 5. Free (unbound) norepinephrine increased significantly across sessions; the post hoc comparisons indicated that mean levels on NOE flight 2 were significantly higher than the mean levels on either of the other flights. Total (unbound plus bound) norepinephrine increased significanlty across sessions and across time periods. Post hoc comparisons also showed that total norepinephrine levels were significantly elevated on NOE flight 2 when compared with the other flights. Free epinephrine increased significantly between the preflight period and the flight

period. Changes in total epinephrine across sessions or time periods were not significant. Although the interaction of these factors was signficant ($p = 0.05$), post hoc comparisons revealed no significant differences between any of the means.

Heart Rate

Heart rate scores were derived from the preflight, end-of-flight, and postflight periods of the three sessions. These scores represent, in beats per minute, a consecutive 10-minute interval as near the end of each period as possible. The resulting data are presented in Table 6. Approximately one-third of the data were lost because of cable movement artifacts, low-amplitude R-waves, and indistinguishable event marks. Consequently, comprehensive statistical analyses did not appear to be justified. However, from the available data it can be observed that during all three flight sessions mean heart rate decreased steadily from the preflight to the postflight period, perhaps reflecting preflight anticipation. Heart rate scores for seven of the eight subjects were available for the preflight and end-of-flight periods of NOE flight 2. These data were used in the correlational analysis described below.

Intercorrelations

In order to evaluate possible relationships among different dependent variables, correlation coefficients were computed between the catecholamine measures and heart rate scores from NOE flight 2 and selected personality variables. On the basis of their expected relevance to stress related physiological events, the State part of the STAI, the Extroversion and Neuroticism scales of the EPQ plus the Self Control, Well Being, Good Impression scales of the CPI were included in these correlational analyses. Preflight and end-of-flight heart rates were significantly correlated ($r_s = 0.88$), i.e., a subject with an elevated preflight heart rate had a relatively high end-of-flight heart rate. Heart rates generally correlated significantly with epinephrine levels, but not with with norepinephrine levels. Preflight heart rates were significantly related to preflight free epinephrine ($r_s = 0.87$) and total epinephrine ($r_s = 0.81$). Similarly, end-of-flight heart rates correlated significantly with inflight total epinephrine levels ($r_s = 0.72$); however, the correlation with inflight free epinephrine levels was not significant. Heart rate scores failed to correlate significantly with any of the selected personality scales. Significant relationships were found between two of the CPI personality scales and free norepinephrine. Good Impression scores correlated significantly with both preflight and inflight levels of free norepinephrine ($r_s = 0.73$ and $r_s = 0.80$, respectively). Similarly, Self Control scores were related to preflight and inflight levels of free norepinephrine 0.83), although the correlation with inflight levels of free norepinephrine did not achieve significance ($r_s = 0.61$). Good Impression and Self Control scores were highly correlated ($r_s = 0.91$). There were no

no significant correlations between the State scores and any of the catecholamine values or heart rates.

DISCUSSION

A number of unforeseen events occurred in this project which hindered analysis and interpretation of the data. First, the anonymity requirement prohibited the evaluation of important relationships that may have existed between personality factors and instructor's ratings of the eight subject pilot's performances. Second, the schedule constraints of the CDEC Program of Instruction combined with our own schedule constraints prevented the use of a consistent task (either navigating or piloting) during successive data collections. Likewise, it was not possible to counterbalance tasks and light conditions effectively. Consequently, the independent variable of light level was confounded by different tasks, the mid-light conditioning involving navigating, and the low-light condition involving piloting. This circumstance made it impossible to evaluate the effects of either light level or tasks independently.

Several points in our results merit further discussion. Only two scales of the twenty-two factors measured indicated the potential to discriminate among the three groups of subjects. Conceptually, the personality factors reflected by these scales could be a potential asset to individuals performing such a demanding task as NOE flying. Specifically, a high score on the Self-acceptance (Sa) scale indicates that the person is "intelligent, outspoken, sharp-witted, demanding, aggressive, and self-centered; ...persuasive and verbally fluent; and ... [has] self-confidence and self-assurance." A high score on the Achievement via Independence (Ai) scale indicates that the person is "mature, forceful, strong, dominant, demanding, and foresighted; ... independent and self-reliant; and ... [has] superior intellectual ability and judgement." At first appearance a high score on both of these scales would not appear surprising, since both possess common descriptors such as intelligence, demanding, and the tendency to be self-confident. However, Gough (20) reports in the CPI manual that almost no relationship exists between these scales ($r = 0.03$), and in the present study four of the five control subjects that were rated average-to-below-average had a score below the mean on one of the two scales, but not necessarily both. This suggests that those aviators that would complete these training exercises successfully would show a pattern of scores wherein both Sa and Ai scales are elevated.

Four of the five IPs had elevated scores across the entire category that involves interpersonal adequacy. These scales reportedly reflect feelings of dominance, capacity for status, sociability, social presence, self-acceptance, and a sense of well-being. The personality characteristics associated with strong interpersonal adequacy would probably be an asset to persons involved in supervising the learning of

a complex, stressful task. However, a larger group of individuals should be evaluated to test the generality of this interpretation.

The EPQ scores did not reveal any consistent pattern of scores that would differentiate any of the three groups of pilots. However, since individuals scores could not be related to any task-related performance, we feel that it would premature to dismiss the use of this questionnaire based on these results.

The lack of significant changes in the GSQ data suggests that fatigue was a minimal factor in this training exercise. The GSQ was unable to discriminate changes in the pilots' subjective state across the three flights. This implies that the subjective experience of fatigue was no greater when piloting under low-light conditions than when observing under high-light conditions. The pilots' comments on the follow-up questionnaire indicated that many of their anticipatory feelings were not evaluated by the GSQ. Thus valuable information may have been overlooked.

Perceived anxiety as measured by the State part (of STAI) was no higher among the subject/pilots than among college undergraduates (22); nor did it change significantly within or across the three flights. This finding mirrors the results of the GSQ. The apparent absence of perceived anxiety reflected in the State data would appear incongruous with the seemingly stressful nature of night NOE flying. It also appears to be incongruous with the catecholamine data which did change significantly both within and across sessions. Further, it may be relevant to note that heart rate tended to decrease within sessions, although not significantly. Thus there appears to be a dissociation between perceived anxiety (subjective experience) and sympathetic nervous system activity as reflected in neuroendocrine and heart rate measures. Similar results were found by Leibrecht, et al. (1978) where elevated heart rate appeared to be dissociated from subjective experience. The apparent lack of sensitivity of the State test may have been due to the scheduling of relatively low stress training phases first, followed by increasingly stressful phases. Perhaps this sequence permitted subjective perceptions to adapt to increasingly stressful conditions, even though sympathetic nervous activity did not. If the order of the three flights studied had been reversed, piloting under low-light conditions may have produced reports of greater anxiety. In any case, it is apparent that the perception of anxiety is not always closely linked to internal physiological states.

Urinary catecholamine levels from approximately two-hour urine samples demonstrated that neuroendocrine activity discriminated between the different conditions in this study. Activities during the flight period produced higher levels of free epinephrine and total norepinephrine than did activities during the preflight period. Similar changes have been reported in previous studies of airline pilots (19). Additionally, both free and total norepinephrine increased across the

three flights. Whether this effect is due to the cumulative effects of the training exercise or to increased stress associated with piloting the aircraft under low-light conditions cannot be determined from the available data.

The substantial correlations between heart rate and epinephrine levels validate, in part, the physiological data and the methods used. This relationship is probably due to the known effect of epinephrine on heart rate (12). There were substantial positive relationships between the Self Control and Good Impression scales of the CPI and free norepinephrine levels. In other words, those with higher levels of free norepinephrine were also more inclined to emphasize good impression and self control. Neither the selected personality factors nor the perceived anxiety ratings correlated significantly with heart rates. Similar results were obtained in the stress field study by Leibrecht et al (1978).

CONCLUSIONS

The intent of this investigation was to evaluate personality factors, subjective symptomatology, heart rate, and catecholamine levels related to performance during a stressful field study training exercise. However, performance could not be evaluated directly and the effects of the stressor (i.e., light level) could not be assessed since the design was not counterbalanced. Several findings were noted in the CPI score profiles of these pilots. Pilots rated above average tended to have above average scores on the Self-acceptance and Achievement via independence scales. Several CPI scales were related to urinary epinephrine and norepinephrine levels; however, with the small number of subjects used these findings should be interpreted cautiously. Despite changes in catecholamine levels across the three flights, the GSQ subscales and, more importantly, the STAI scores did not suggest any increase in perceived anxiety. One possible explanation for the lack of increase in perceived anxiety despite fluctuations in some physiological functions may involve the process of dissociation and the general adaptation syndrome concept (10,11).

RECOMMENDATIONS

1. In future research where a collaborative effort is required, each investigating team should be involved in the planning stage as early as possible. This will enable the requirements of each group to be established and evaluated and will increase the likelihood of a more fruitful endeavor.

2. A procedure must be established whereby an individual's data can be made available to all authorized investigators. In the present report, the potentially valuable performance data were not available to LAIR since it was judged as a violation of the individual's right to anonymity. One possible alternative could be to specify in the anonymity

statement the groups that may have access to the data and those that are excluded. Another approach could involve the use of a common computer file where the data are coded with a subject's number, unknown by the investigator. The numbers and names could be known by one person who would collate the data.

3. It is suggested that the CPI be given to future night NOE aviator candidates prior to training so that a larger data base would be available to verify some of the correlations noted in this report.

REFERENCES

1. KIMBALL, K.A., T.L. FRIZELL, M.A. HOFFMAN, and A.C. SNOW. Aviator Performance using Local Area, Low Level and Nap-of-the-Earth Flight. Report No. 75-3. Ft. Rucker, AL: US Army Aeromedical Research Laboratory, September 1974

2. LEES, M.A., D.D. GLICK, K.A. KIMBALL, and A.C. SNOW, JR. In-Flight Performance with Night Vision Goggles during Reduced Illumination. Report No. 76-27. Ft. Rucker, AL: US Army Aeromedical Research Laboratory, August 1976

3. LEES, M.A., K.A. KIMBALL, M.A. HOFFMAN, and L.W. STONE. Aviator Performance during Day and Night Terrain Flight. Report No. 77-3. Ft. Rucker, AL: US Army Aeromedical Research Laboratory, December 1976

4. EYSENCK, H.J. The Biological Basis of Personality. Springfield, IL: Charles C. Thomas Publisher, 1967

5. SANDERS, M.G., M.A. HOFFMAN, P.D. HUNT, and A.C. SNOW, JR. Personality Aspects of Pilot-error Accident Involvement. Report No. 75-1. Ft. Rucker, AL: US Army Aeromedical Research Laboratory, July 1974

6. WEISER, P.C., R.A. KINSMAN, and D.A. STAMPER. Task-specific symptomatology changes resulting from prolonged submaximal bicycle riding. Med Sci Sports 5:79-85, 1973

7. KINSMAN, R.A., P.C. WEISER, and D.A. STAMPER. Multidimensional analysis of subjective symptomatology during prolonged strenuous exercise. Ergonomics 16:211-226, 1973

8. STAMPER, D.A., R.T. STERNER, and R.A. KINSMAN. Symptomatology subscales for the measurement of acute mountain sickness. Percept Motr Skills 33:735-742, 1971

9. STAMPER, D.A. Physiological, Psychological, and Symptomatic Factors Affecting Prolonged Physical Performance. Master's Thesis, University of Colorado, 1976 (unpublished)

10. SELYE, H.A. A syndrome produced by diverse nocuous agents. Nature 138:32 , 1936

11. SELYE, H.A. The general adaptation syndrome and the diseases of adaptation. J Clin Endocr 6:117-230, 1946

12. MONTCASTLE, V.B. Medical Physiology. St. Louis: C.V. Mosby Company, 1974. pp 870-871

13. MCGRATH, J.E. (Ed.) Social and Psychological Factors in Stress. New York: Holt, Rinehart and Winston, 1970

14. ELLIOTT, R. Effects of uncertainty about the nature and advent of a noxious stimulus (shock) upon heart rate. J Pers Soc Psychol 3:353-357, 1966

15. FENZ, W.D. Conflict and stress as related to physiological activation and sensory perceptual and cognitive functioning. Psychol Monogr: Gen and Appl 78(8, Whole No. 585), 1964

16. KATKIN, E.S. Relationship between manifest anxiety and two indices of antonomic response to stress. J Pers Soc Psychol 2:324-333, 1964

17. SCHACHTER, S. and J.E. SINGER. Cognitive, social, and physiological determinants of emotional state. Psychol Rev 69:379-399, 1962

18. GROSSMAN, S.P. A Textbook of Physiological Psychology. New York: John Wiley and Sons, Inc., 1967. pp 513-515

19. MASON, J.W. A review of psychoendocrine research on the sympathetic adrenal medullary system. Psychom Med 30(5, Part 2):631-653, 1968

20. GOUGH, H.G. California Psychological Inventory Manual. Palo Alto, CA: Consulting Psychologists Press, Inc., 1975

21. EYSENCK, H.J. and S.B.G. EYSENCK. The Manual of the Eysenck Personality Questionnaire. San Diego: EDITS/Robert R. Knapp, Publisher, 1975

22. SPIELBERGER, C.D., R.L. GORSUCH, and R.E. LUSHENE. STAI Manual. Palo Alto, CA: Consulting Psychologists Press, 1970

23. BORG, G. Perceived exertion in relation to physical work load and pulse rate. K Frysiogn Saellsk 31:105-115, 1961

24. BRUNING, J.L. and B.L. KINTZ. Computational Handbook of Statistics. Glenview, IL: Scott, Foresman Company, 1968

25. FERGUSON, G.A. Statistical Analysis in Psychology and Education. New York: McGraw-Hill Book Company, 1966

26. WINER, B.J. Statistical Principles in Experimental Design. New York: McGraw-Hill Book Company, 1971

27. SIEGEL, S. Nonparametric Statistics for the Behavioral and Social Sciences. New York: McGraw-Hill Book Company, 1956

General States Questionnaire (GSQ) (Form 76)

APPENDIX A

APPENDIX A

GSQ (Form 76)

This questionnaire is concerned with several aspects of peoples' feelings. During the course of the current study, you will be asked to complete the questionnaire a number of times. Since it is important for us to know exactly how you are feeling each time that you take the questionnaire, you are urged to be as open and honest as possible when answering the items.

INSTRUCTIONS:

A separate Answer Sheet will be provided each time you are to fill out the questionnaire. Be sure to mark your answers on on the Answer Sheet.

Questionnaire Instructions. On the following pages, there are a number of phrases describing aspects of a person's feelings. Consider each item, and then mark the appropriate block on the Answer Sheet which best describes your feelings concerning the item.

Consider the following example:

1	2	3	4	5
extremely cold	considerably cold	moderately cold	slightly cold	not at all cold

A person who feels "slightly cold" should respond by marking a "4" on the Answer Sheet.

Player Number

1	2	3	4	5	6	7	8
4							

(On Answer Sheet)

77	78	79	80

	1	2	3	4	5
1)	severe nausea	considerable nausea	moderate nausea	slight nausea	no nausea
2)	extremely tired	considerably tired	moderately tired	slightly tired	not at all tired
3)	not at all sleepy	slightly sleepy	moderately sleepy	considerably sleepy	extremely sleepy
4)	severe arm cramps	considerable arm cramps	moderate arm cramps	slight arm cramps	no arm cramps
5)	no deep breathing	slightly deep breathing	moderately deep breathing	very deep breathing	extremely deep breathing
6)	excellent concentration	good concentration	satisfactory concentration	less than adequate concentration	poor concentration
7)	extremely willing to endure discomfort	very willing to endure discomfort	moderately willing to endure discomfort	slightly willing to endure discomfort	not at all willing to endure discomfort
8)	extremely vigorous	considerably vigorous	moderately vigorous	slightly vigorous	not at all vigorous
9)	extremely happy	considerably happy	moderately happy	slightly happy	not at all happy
10)	no aching leg muscles	slight aching leg muscles	moderate aching leg muscles	considerable aching leg muscles	severe aching leg muscles
11)	no tightening of head and neck muscles	slight tightening of head and neck muscles	moderate tightening of head and neck muscles	considerable tightening of head and neck muscles	severe tightening of head and neck muscles

	1	2	3	4	5
12)	not at all forgetful	a little forgetful	moderately forgetful	considerably forgetful	very forgetful
13)	indifferent concerning outperforming other players	slightly want to outperform other players	moderately want to outperform other players	considerably want to outperform other players	very much want to outperform other players
14)	extremely dizzy	considerably dizzy	moderately dizzy	slightly dizzy	not at all dizzy
15)	very severe headache	severe headache	moderate headache	slight headache	no headache
16)	not at all active	slightly active	moderately active	considerably active	extremely active
17)	extremely short tempered	considerably short tempered	moderately short tempered	slightly short tempered	not at all short tempered
18)	no heavy legs	slightly heavy legs	moderately heavy legs	very heavy legs	extremely heavy legs
19)	not at all energetic	slightly energetic	moderately energetic	considerably energetic	extremely energetic
20)	extremely pleased	considerably pleased	moderately pleased	slightly pleased	not at all pleased
21)	not at all refreshed	slightly refreshed	moderately refreshed	considerably refreshed	extremely refreshed
22)	severe arm twitching	considerable arm twitching	moderate arm twitching	slight arm twitching	no arm twitching
23)	extremely distractible	very distractible	moderately distractible	slightly distractible	not at all distractible

	1	2	3	4	5
24)	extremely exhausted	considerably exhausted	moderately exhausted	slightly exhausted	not at all exhausted
25)	no aching arm muscles	slight aching arm muscles	moderate aching arm muscles	considerable aching arm muscles	severe aching arm muscles
26)	extremely irritable	considerably irritable	moderately irritable	slightly irritable	not at all irritable
27)	extreme dimness of vision	considerable dimness of vision	moderate dimness of vision	slight dimness of vision	no dimness of vision at all
28)	not at all short of breath	slightly short of breath	moderately short of breath	considerably short of breath	extremely short of breath
29)	severe leg twitching	considerable leg twitching	moderate leg twitching	slight leg twitching	no leg twitching
30)	very lazy	considerably lazy	moderately lazy	slightly lazy	not at all lazy
31)	extremely drowsy	considerably drowsy	moderately drowsy	slightly drowsy	not at all drowsy
32)	no head throbbing	slight head throbbing	moderate head throbbing	considerable head throbbing	severe head throbbing
33)	no heavy arms	slightly heavy arms	moderately heavy arms	very heavy arms	extremely heavy arms
34)	extremely alert	very alert	moderately alert	somewhat alert	not at all alert

	1	2	3	4	5
35)	no heart pounding	some heart pounding	moderate heart pounding	considerable heart pounding	severe heart pounding
36)	poor attention	less than adequate attention	satisfactory attention	good attention	excellent attention
37)	extremely satisfied	considerably satisfied	moderately satisfied	somewhat satisfied	not at all satisfied
38)	severe leg cramps	considerable leg cramps	moderate leg cramps	slight leg cramps	no leg cramps
39)	not at all difficult to breathe	somewhat difficult to breathe	moderately difficult to breathe	considerably difficult to breathe	extremely difficult to breathe
40)	not at all worn out	slightly worn out	moderately worn out	considerably worn out	extremely worn out
41)	indifferent concerning performing well	slightly want to perform well	moderately want to perform well	considerably want to perform well	very much want to perform well

Briefing of Subjects

Volunteer Agreement

APPENDIX B

APPENDIX B

BRIEFING OF SUBJECTS

The purpose of this study is to examine certain psychological functions during field performance. We have studied psychological, physiological, and biochemical functions in members of the 155th Aviation Company participating in the HONEST I Exercise. The data we gather from you will give us more complete information on psychological aspects. The psychological measures consist of two personality questionnaires; one questionnaire to evaluate current feelings, plus a coding performance task. We ask that you complete these forms as honestly and accurately as you can.

Your participation in this study will involve no hazards to your health or person. All information gathered during the study will be treated with strict anonymity. This will be done in the following manner: test answer sheets will have a different number. Please select one of these sets and keep the same number throughout this study. All data collected will be recorded by this number. In no way will there be an opportunity to relate this data to one particular individual. Therefore, full anonymity will be maintained.

APPENDIX B (CONT)

VOLUNTEER AGREEMENT

I, ______________________________, having attained my eighteenth (18) birthday and otherwise having full capacity to consent, do hereby volunteer to participate in a research study of psychological correlates of field performance, being conducted by the Letterman Army Institute of Research in conjunction with the HONEST I project of Combat Developments Experimentation Command.

The implications of my voluntary participation; the nature, duration and purpose; the methods and the means by which it is to be conducted; and the inconveniences which may reasonably be expected have been explained to me by CPT Bruce C. Leibrecht, and are set forth in the attachment to this agreement, which I have initialed. I have been given an opportunity to ask questions concerning this investigational study, and any such questions have been answered to my full and complete satisfaction.

I understand that I may at any time during the course of this study revoke my consent and withdraw from the study without prejudice.

______________________________ __________
Signature Date

I was present during the explanation referred to above as well as the volunteer's opportunity for questions, and hereby witness his signature.

______________________________ __________
Witness' Signature Date

LEGENDS OF FIGURES

Fig 1 California Psychological Inventory scale scores for the subject, instructor, and average-to-below-average pilots. Abbreviations: Do=Dominance, CS=Capacity for Status, Sy=Sociability, Sp=Social Presence, Sa=Self-acceptance, Wb=Sense of Well-being, Re=Responsibility, So=Socialization, Sc=Self-control, To=Tolerance, Gi=Good Impression, Cm=Community, Ac=Achievement via Conformance, Ai=Achievement via Independence, Ie=Intellectual Efficiency, Py=Psychological-mindedness, Fx=Flexibility, Fe=Feminity.

Fig 2 Eysenck Personality Questionnaire scale scores for eight subject pilots.

Fig 3 Pre-flight (P) and end-of-flight (F) General States Questionnaire subscale scores for eight subject pilots.

APPENDIX C

CALIFORNIA PSYCHOLOGICAL INVENTORY SCALES

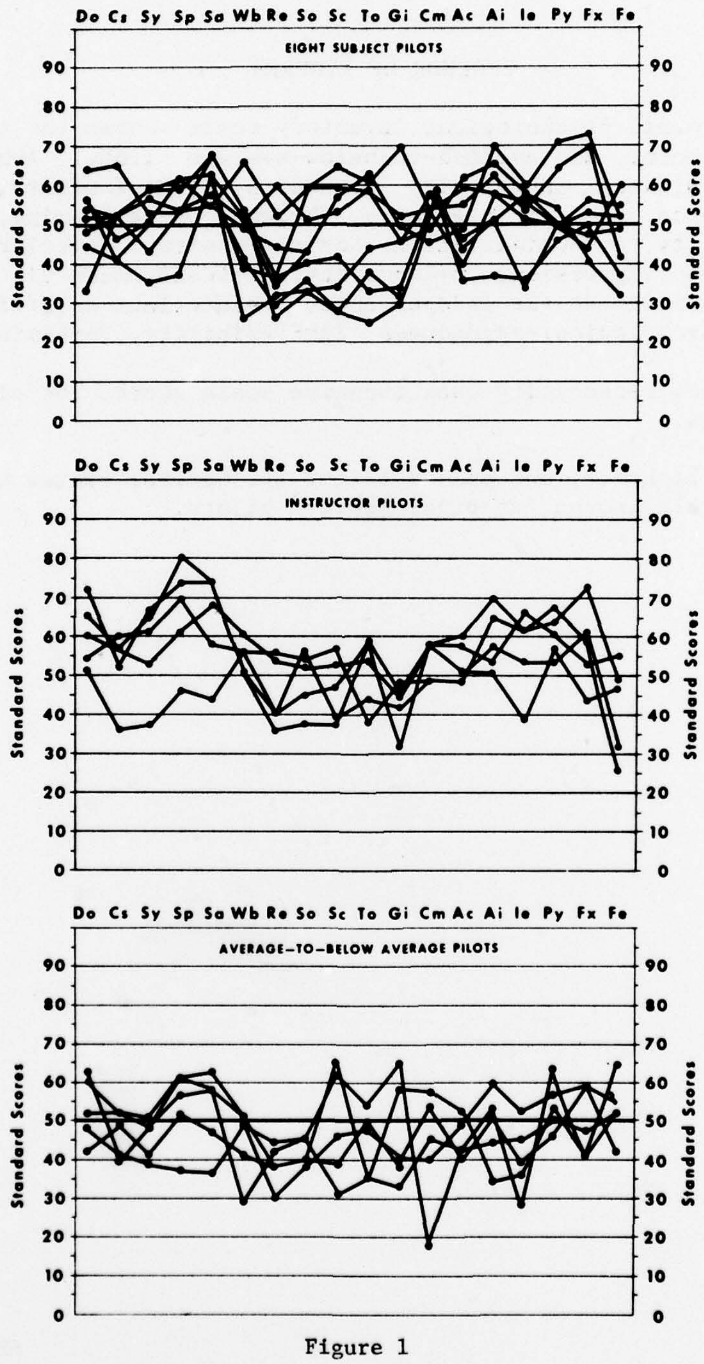

Figure 1

EYSENCK PERSONALITY QUESTIONNAIRE SCALES

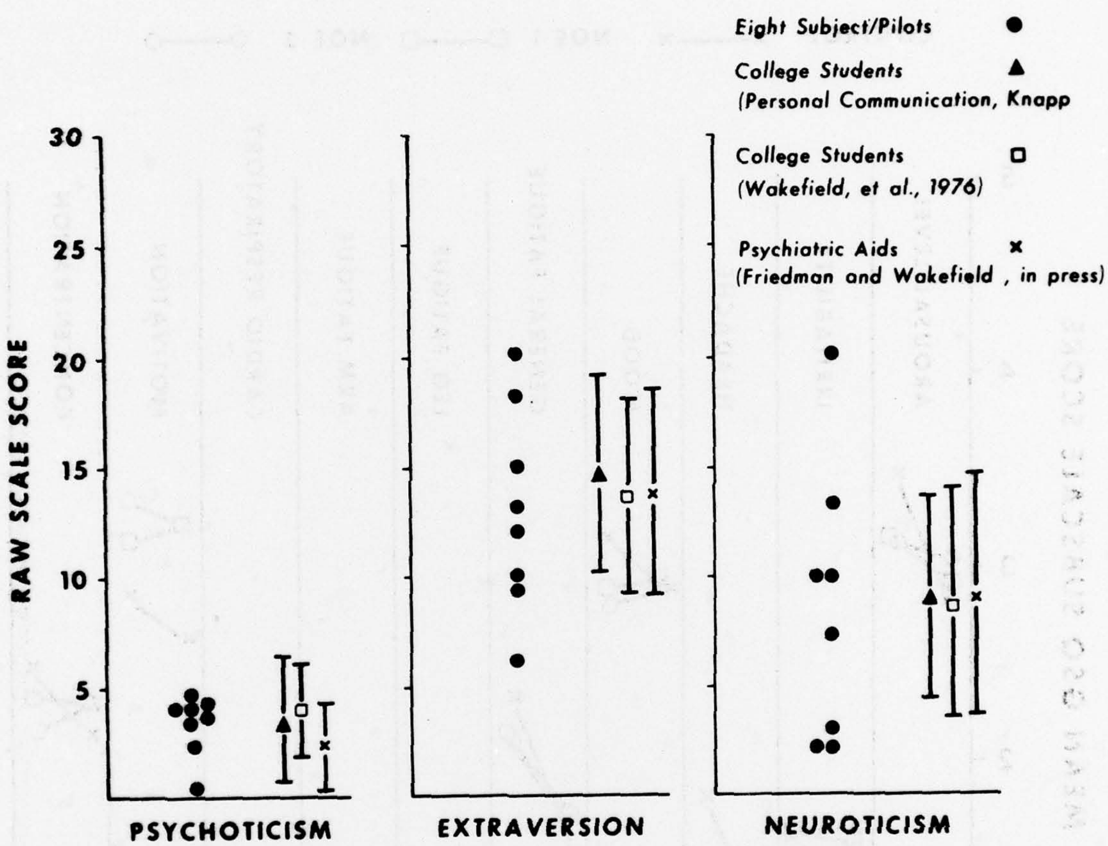

Figure 2

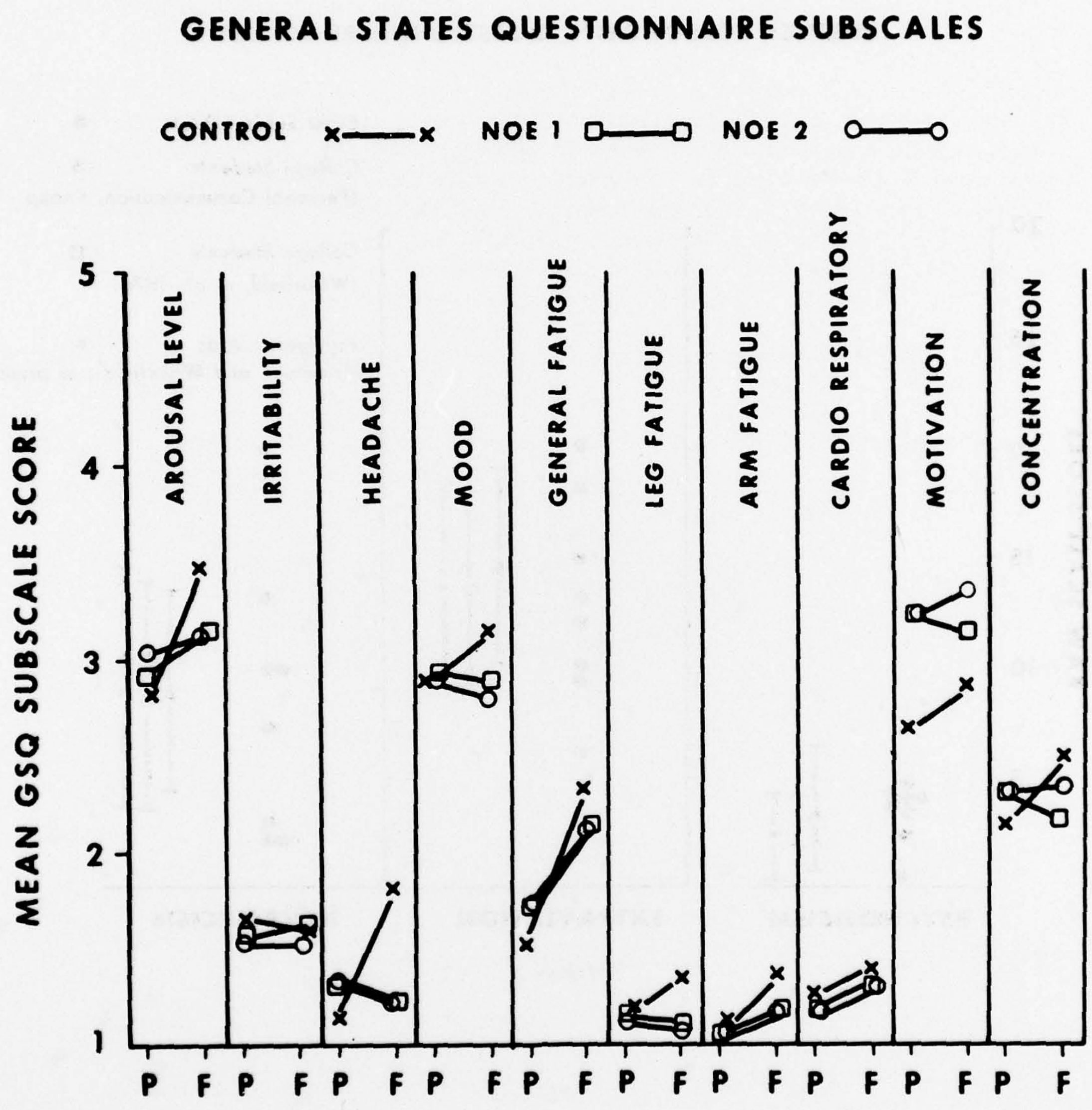
GENERAL STATES QUESTIONNAIRE SUBSCALES
CONTROL
NOE 1
NOE 2
MEAN GSQ SUBSCALE SCORE
1
2
3
4
5
AROUSAL LEVEL
IRRITABILITY
HEADACHE
MOOD
GENERAL FATIGUE
LEG FATIGUE
ARM FATIGUE
CARDIO RESPIRATORY
MOTIVATION
CONCENTRATION
P F P F P F P F P F P F P F P F P F P F

Figure 3

TITLES OF TABLES

APPENDIX D

TABLE 1

CALIFORNIA PSYCHOLOGICAL INVENTORY RAW SCALE SCORES FOR

SUBJECT, INSTRUCTOR, AND AVERAGE-TO-BELOW-AVERAGE PILOTS

Group	Subject Number	Do	Cs	Sy	I Sp	Sa	Wb	Re	So	Sc	II To	Gi	Cm	III Ac	Ai	Ie	IV Py	Fx	Fe
A Subject Pilots	1	34	25	26	36	21	44	32	42	28	28	32	26	32	22	42	11	8	16
	2	32	20	29	39	26	39	19	27	19	20	17	27	26	18	43	12	6	9
	3	29	20	29	40	24	34	21	29	15	17	9	26	23	22	40	11	10	17
	4	24	16	17	27	23	33	24	31	25	15	9	27	25	19	32	11	7	20
	5	28	20	28	36	22	38	36	37	33	27	17	25	33	25	43	11	11	18
	6	30	18	25	40	21	37	28	43	36	29	20	24	27	27	44	17	17	16
	7	26	20	21	36	25	38	23	42	38	27	21	26	30	24	41	15	17	13
	8	30	16	25	40	24	28	23	27	14	11	9	27	21	13	33	10	9	11
B Instructor	1	32	22	26	40	26	42	33	38	33	25	17	27	31	20	47	14	10	18
	2	38	20	33	47	28	38	26	40	23	20	15	25	27	22	41	12	13	9
	3	29	23	30	44	22	40	26	34	29	27	18	27	32	27	45	15	17	16
	4	35	22	32	50	28	38	24	30	22	27	9	27	27	25	45	16	12	7
	5	29	14	18	32	17	40	34	39	36	17	19	25	28	19	34	13	7	15
C Average-To-Below-Average Pilots	1	28	20	24	38	22	38	25	41	31	16	25	27	29	12	33	12	6	17
	2	23	19	20	35	18	34	25	31	22	23	13	26	23	19	34	10	12	18
	3	33	15	24	40	22	29	27	34	17	16	10	24	24	16	37	11	8	17
	4	32	20	25	40	24	37	21	30	28	22	14	23	27	23	40	13	12	13
	5	26	16	19	27	14	37	28	34	40	25	29	18	24	20	29	15	6	22

*Do=Dominance, Cs=Capacity for Status, Sy=Sociability, Sp=Social Presence, Sa=Self-acceptance, Wb=Well Being, Re=Responsibility, So=Socialization, Sc=Self Control, To=Tolerance, Gi=Good Impression, Cm=Communality, Ac=Achievement via Conformance, Ai=Achievement via Independence, Ie=Intellectual Efficiency, Py=Psychological-mindedness, Fx=Flexibility, Fe=Feminity.

TABLE 2

EYSENCK PERSONALITY QUESTIONNAIRE RAW SCALE SCORES

FOR SUBJECT, INSTRUCTOR, AND AVERAGE-TO-BELOW-AVERAGE PILOTS

Group	Subject Number		Extroversion	Psychoticism	Neuroticism	Lie
Subject Pilots	1		10	0	2	11
	2		20	2	7	3
	3		15	5	10	3
	4		6	4	20	5
	5		12	3	10	2
	6		13	4	3	8
	7		9	4	2	3
	8		18	3	13	1
		Mean	12.9	3.1	8.4	4.5
		SD ±	4.7	1.6	6.2	3.4
Instructor Pilots	1		15	2	7	2
	2		21	7	8	2
	3		13	3	7	5
	4		15	6	4	1
	5		12	4	13	3
		Mean	15.2	4.4	7.8	2.6
		SD ±	3.5	2.1	3.3	1.5

TABLE 2 (CONCLUDED)

EYSENCK PERSONALITY QUESTIONNAIRE RAW SCALE SCORES

FOR SUBJECT, INSTRUCTOR, AND AVERAGE-TO-BELOW-AVERAGE PILOTS

Group	Subject Number		Extroversion	Psychoticism	Neuroticism	Lie
Average-To	1		17	1	4	8
Below-Average	2		14	3	21	5
Pilots	3		7	1	9	4
	4		19	9	7	8
	5		10	5	1	11
		Mean	13.4	3.8	8.4	7.2
		SD ±	4.9	3.4	7.7	2.8
Preliminary Normative Data						
College Students		Mean	14.4	4.1	8.2	5.6
		SD +	4.6	3.1	5.6	3.0
College Students (Wakefield et al, 1972)		Mean	13.7	4.5	8.8	6.9
		SD ±	4.3	2.3	5.4	3.7
Psychiatric Aids (Friedman & Wakefield in press)		Mean	13.9	2.4	9.1	10.0
		SD ±	4.7	2.2	5.7	5.0

TABLE 3

STATE-TRAIT RAW SCALE SCORES OF THE EIGHT SUBJECT PILOTS

FOR THE INITIAL BRIEFING AND THE THREE FLIGHTS

Subject	Briefing		Demonstration Flight		Navigation Flight		Piloting Flight	
	Trait*	State	State Pre	State Post	State Pre	State Post	State Pre	State Post
1	25	24	25	26	26	25	25	28
2	25	31	29	20	20	20	20	29
3	38	42	39	40	50	45	47	39
4	46	34	40	38	31	35	30	24
5	39	41			47	38	47	42
6	27	33	32	25	48	34	33	51
7					39	41	27	46
8	30	40	38	29	32	21	24	48
Mean	32.8	35.0	33.8	29.7	36.6	32.4	31.6	38.4
SD ±	7.6	6.5	6.1	7.8	11.1	9.4	10.2	10.2

*The Trait scale was given only during the briefing session.

TABLE 4

PRE- AND POSTFLIGHT URINARY CATECHOLAMINE LEVELS OF THE EIGHT SUBJECTS

ACROSS THE THREE FLIGHTS

Subject Number	Demonstration Flight		Navigation Flight		Piloting Flight	
	Pre	Post	Pre	Post	Pre	Post
Free Norepinephrine						
1	42.47*	38.03	48.00	46.95	59.71	61.70
2	30.19	29.79	27.93	41.77	23.89	36.68
3	30.59	31.43	36.91	34.88	31.21	33.81
4	33.05	19.70	22.60	28.81	36.30	23.97
5	19.04	20.06	27.99	24.47	32.29	26.09
6	31.43	32.33	38.57	29.51	91.15	75.66
7	25.24	21.75	29.22	25.28	47.95	42.24
8	18.25	19.16	32.39	40.18	38.21	48.07
Total Norepinephrine						
1	136.02	156.91	85.45	85.97	312.21	255.00
2	30.85	57.69	61.70	86.37	140.43	191.27
3	41.43	68.66	50.34	82.56	164.93	145.06
4	30.06	83.50	48.83	61.86	39.45	54.69
5	78.81	152.79	99.46	89.47	130.43	125.81
6	45.44	64.94	77.76	92.29	367.36	437.69
7	46.90	71.44	73.10	55.09	110.25	94.86
8	80.45	75.10	117.54	124.54	99.48	152.17

TABLE 4 (CONCLUDED)

PRE- AND POSTFLIGHT URINARY CATECHOLAMINE LEVELS OF THE EIGHT SUBJECTS

ACROSS THE THREE FLIGHTS

Subject Number	Demonstration Flight		Navigation Flight		Piloting Flight	
	Pre	Post	Pre	Post	Pre	Post
Free Epinephrine						
1	1.52	1.12	8.34	10.13	5.96	9.80
2	8.22	16.89	8.30	7.70	8.09	6.73
3	2.94	9.38	2.00	16.12	7.00	18.18
4	1.11	1.33	3.10	.72	10.45	6.34
5	12.53	10.64	.61	3.32	7.46	10.26
6	4.78	5.97	10.75	12.01	3.49	7.12
7	19.08	33.92	8.97	22.03	9.10	9.77
8	5.93	11.16	9.03	10.61	4.46	12.22
Total Epinephrine						
1	16.67	20.72	11.93	15.71	5.96	17.20
2	15.59	19.83	13.83	33.72	11.60	14.00
3	16.13	35.89	20.74	46.98	14.93	24.49
4	7.78	12.62	8.01	8.81	23.40	22.22
5	13.72	7.28	7.48	7.50	7.04	9.30
6	23.08	20.85	18.26	15.03	42.69	16.23
7	27.47	37.91	14.91	26.93	46.48	27.62
8	19.77	22.27	23.21	41.41	18.58	25.24

! *Values represent µg/g creatinine

TABLE 5

SUMMARY OF THE 3 X 2 REPEATED MEASURES ANALYSIS

OF VARIANCE* FOR URINE CATECHOMAMINES

Source	df	Free Norepinephrine MS	Free Norepinephrine F†	Total Norepinephrine MS	Total Norepinephrine F†	Free Epinephrine MS	Free Epinephrine F†	Total Epinephrine MS	Total Epinephrine F†
Flights (A)	2	1161.24	5.72	64938.13	8.68	2.84		2.65	
Error (A)	14	203.17		7482.82		46.48		87.70	
Preflight/ Flight (B)	1	8.55		3284.35	7.78	169.69	6.04	210.42	
Error (B)	7	54.55		422.41		28.08		112.13	
A X B	2	11.42		566.35		1.63		133.16	3.72
Error (B)	14	20.82		480.60		9.32		35.79	

* BMDP2V from the Biomedical Computer Program was used to compute these analyses.
† Only significant F values have been presented in this table.

TABLE 6

MEAN HEART RATES OF EIGHT SUBJECT PILOTS

FOR THE THREE FLIGHTS

	Demonstration Flight			Navigation Flight			Piloting Flight		
Subject	Pre*	Flight	Post	Pre	Flight	Post	Pre	Flight	Post
1	**	___	___	___	___	___	63.0	55.4	___
2	85.8***	83.0	___	76.8	61.6	59.1	79.1	72.1	___
3	___	62.2	78.9	68.6	63.5	63.1	78.5	74.0	___
4	___	73.4	75.6	___	___	___	89.5	78.3	___
5	75.7	82.8	72.4	79.1	79.2	75.8	63.7	60.8	69.2
6	95.6	103.0	78.2	82.9	88.6	___	79.9	73.5	___
7	79.4	76.5	___	___	74.3	___	88.3	78.3	___
8	___	___	___	___	___	___	___	___	___

* Pre=Preflight; Flight=Inflight; Post=Postflight.
** A ____ denotes missing data
*** Values represent average beats/min for ten minute period